

Can acute ingestion of Citrulline Malate alter substrate utilisation during a cardiorespiratory exercise test with healthy participants?

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Introduction

- ◆ Ingestion of Citrulline Malate (CM) has been shown to improve exercise with beneficial effects reported during strength-based assessments and time trial performance¹.
- ◆ CM has been reported to increase plasma arginine availability (see figure 1) and subsequent nitric oxide (NO) production, leading to increased blood flow.
- ◆ Citrulline, in particular, accelerates the ureagenesis cycle resulting in the removal of ammonium, while Malate is essential for oxidative metabolism which regulates skeletal muscle functions including glucose and fatty acid oxidation.
- ◆ Despite this, the metabolic influence of CM has received little attention in the literature. Much of the current literature has primarily focused on performance outcomes during high intensity exhaustive exercise.
- ◆ The purpose of this study was to investigate the effects of CM on substrate utilisation during a low-to-moderate cardiorespiratory exercise test.

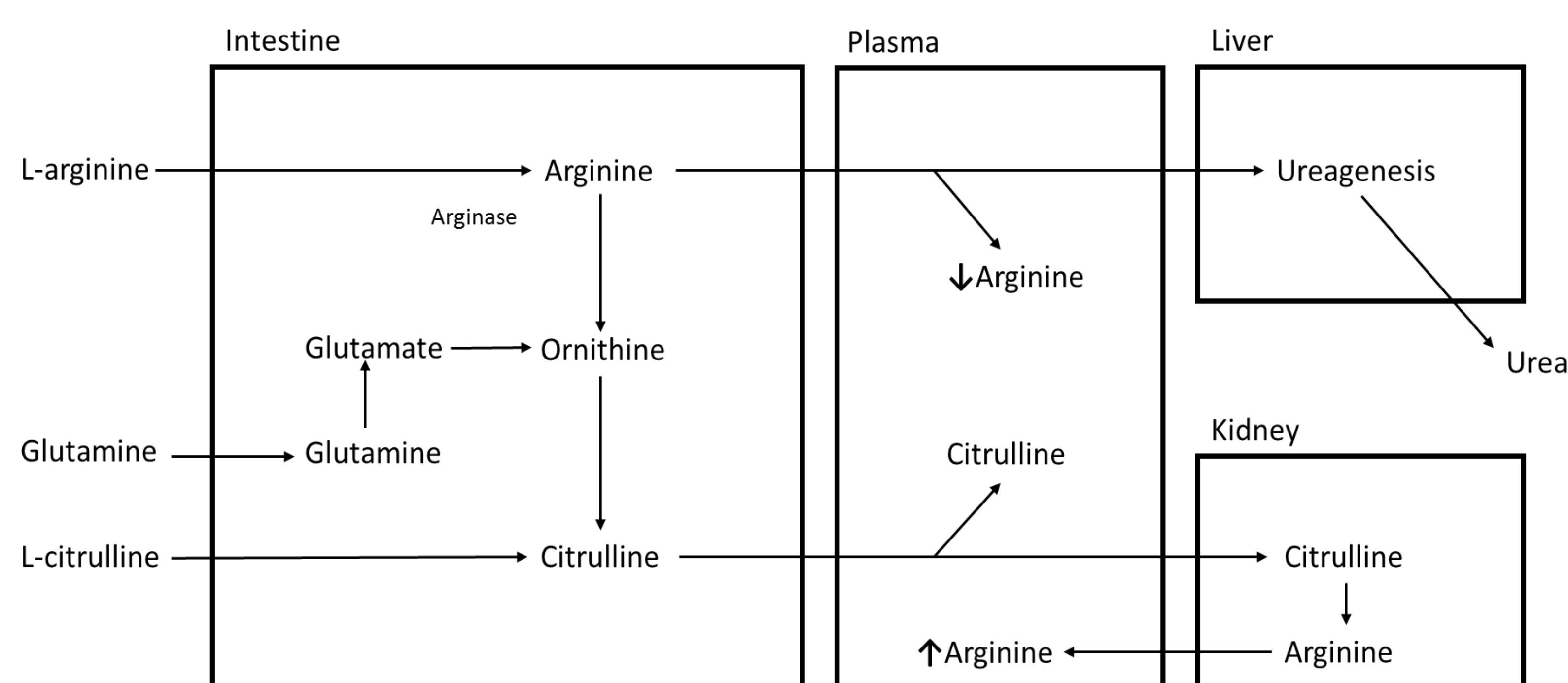
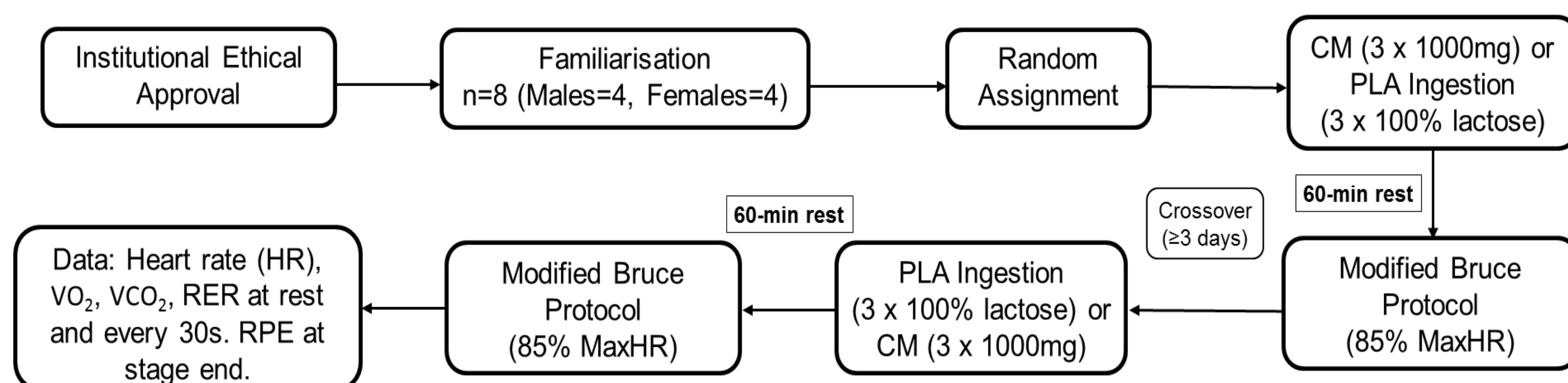


Figure 1. The inter-organ pathway taken by L-arginine, Glutamine and L-citrulline.

Methods



- ◆ A factorial repeated-measures analysis of variance (ANOVA) was designed with two levels of condition (CM & PLA) and multiple levels of time (2x7 VO₂, VCO₂, RER, FAO, CHO, HR & RPE at rest and during exercise). Bonferroni post-hoc tests were deployed and effect sizes (Cohen's *d*) calculated.

Results

- ◆ There was no significant difference reported for the time (min) to complete the exercise test ($P>0.05$). No statistical difference was found between conditions for FAO and CHO ($\text{g}\cdot\text{min}^{-1}$) at any time point (see figure 2).
- ◆ All other data showed no significant difference (all $P>0.05$) in the pre-exercise rest period or at any stage during the exercise test. Main effects similarly showed no significant difference ($P>0.05$).

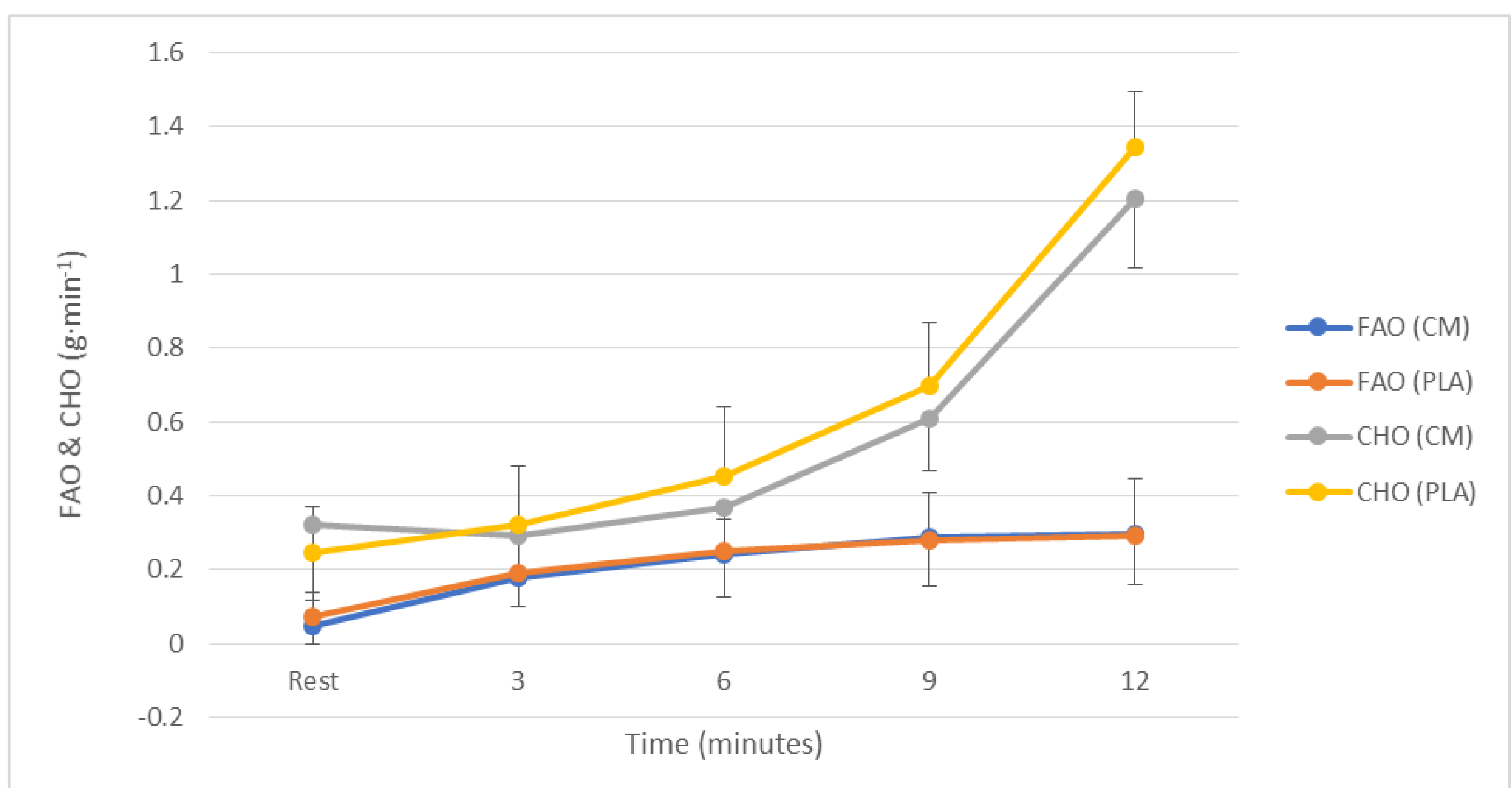


Figure 2. Fatty acid (FAO) and carbohydrate oxidation (CHO) during submaximal exercise following ingestion of CM or PLA.

Summary and Conclusion

- ◆ Under strict, controlled laboratory conditions and the use of randomisation in design, this novel control trial compared the effects of a low-dose of CM to a PLA under low-to-moderate intensity exercise.
- ◆ Interestingly, this experiment found little to support the hypothesis of CM influencing metabolism under these conditions with healthy participants.
- ◆ These findings add to a growing research area on CM supplementation and adaptations to this type of trial are possible (dosage/exercise test/sample) for further study.

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References

1. Suzuki, T., Morita, M., Kobayashi, Y., & Kamimura, A. (2016). Oral L-citrulline supplementation enhances cycling time trial performance in healthy trained men: Double-blind randomised placebo-controlled 2-way crossover study. *Journal of The International Society of Sports Nutrition*, 13, 6.
2. Alkhatib, A., Seijo, M., Larumbe, E., & Naclerio, F. (2015). Acute effectiveness of a "fat-loss" product on substrate utilisation, perception of hunger, mood state and rate of perceived exertion at rest and during exercise. *Journal of The International Society of Sports Nutrition*, 12(1), 1-8.

- ◆ Respiratory data was subsequently entered into stoichiometric equations to calculate fatty acid oxidation (FAO; $\text{g}\cdot\text{min}^{-1}$) and carbohydrate oxidation (CHO; $\text{g}\cdot\text{min}^{-1}$), equations 1 and 2 respectively².

$$(1) \text{FAO} = 1.695 \times \text{VO}_2 - 1.701 \times \text{VCO}_2$$

$$(2) \text{CHO} = 4.585 \times \text{VCO}_2 - 3.226 \times \text{VO}_2$$

- ◆ Data Analysis: A paired samples t-test was conducted to compare the time to complete the exercise test following either CM or PLA consumption.